

6. INFRASTRUCTURE ARCHITECTURE

IT Direction			
Business Architecture	Information Architecture	Application Architecture	Infrastructure Architecture
Security Architecture			
Enterprise Architecture Management (EAM)			

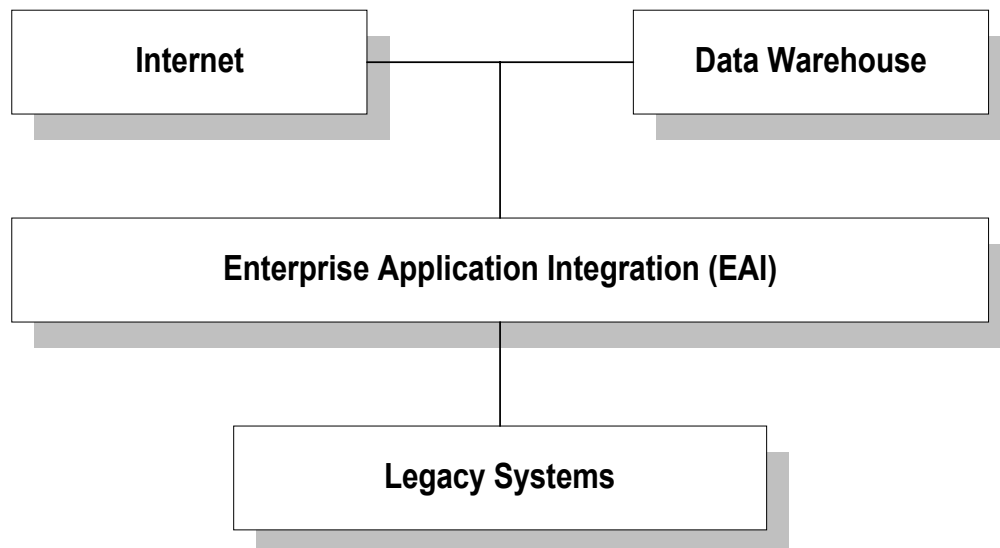
6.1 Overview

This section describes the technologies that make up SFA's infrastructure architecture. These encompass the following: Internet architecture, enterprise application integration architecture, data warehouse architecture, development architecture and legacy systems architecture. More detailed descriptions are given in "Integrated Technical Architecture Detailed Design Document," Volumes 1-6.

The infrastructure architecture is being driven by the enterprise-wide business goals, in accordance with the vision and guiding principles outlined in the CIO Vision.

Exhibit 6-1 gives a conceptual view of SFA's infrastructure architecture:

Exhibit 6-1: SFA Infrastructure Architecture



6.2 Infrastructure Components

6.2.1 Internet Architecture

The Internet Architecture is made up of hardware, software and network components. The SFA Internet Architecture consists of twelve major components. These components provide the basic processing and cross relationship of the ITA Internet enterprise. The Internet Architecture provides an interface for legacy applications and Internet-based applications through an information portal. The primary purposes of the twelve components of the SFA Internet Architecture are as follows:

- Web Browser provides user access to the Internet Architecture.
- Firewall protects SFA resources against direct and indirect intrusion.
- Load Balancing distributes client work across a set of applications.
- Web Server provides document management, handling client request, processing scripts and caching Web pages.
- Application Server provides access to legacy systems, databases and other application servers.
- Component Broker provides a number of services to business objects and enterprise beans.
- Content Management manages Website content delivery from development to production.
- Portal provides a customizable and personalized interface as a single access point to a wide variety of data sources.
- Knowledge Management provides the information search and retrieval capability.
- Directory Services manages information common to applications, individuals and groups of individuals.
- File Storage provides the handling of request at the file and directory level.
- Database Server provides a consistent relational interface to information contained in a database.

Exhibit 6-2 below outlines the twelve major functions of the SFA's Internet Architecture.

Exhibit 6-2: Internet Architecture

Web Browser <ul style="list-style-type: none">• Presentation display• User interaction• Server communication	Firewall <ul style="list-style-type: none">• Internet security• Intranet security	Load Balancing <ul style="list-style-type: none">• Distributes IP traffic• Makes service available
Web Server <ul style="list-style-type: none">• Application services• Presentation logic• Client communication	Application Server <ul style="list-style-type: none">• Business component access• Web communications	Component Broker <ul style="list-style-type: none">• Business component administration• Business component interfaces
Content Management <ul style="list-style-type: none">• Versioning• Publishing• Development	Portal <ul style="list-style-type: none">• Single access point• Customization• Personalization	Knowledge Management <ul style="list-style-type: none">• Search engine• Retrieve• E-mailer
Directory Server <ul style="list-style-type: none">• Resource access control• Name and domain services	File Storage <ul style="list-style-type: none">• Persistent file storage	Database Server <ul style="list-style-type: none">• Storage• Access• Replication

6.2.2 Enterprise Application Integration Architecture

Enterprise Application Integration (EAI) is a set of technology services that enables the sharing of processes and data of disparate systems to support end-to-end business processes. The SFA EAI architecture will enable the many “stovepipe” applications to exchange information via common, reusable methods and infrastructure. EAI will allow the integration of new web-based applications, the data warehouse environment, commercial-off-the-shelf (COTS) packages and existing legacy systems within the SFA technical environment, while at the same time providing a means to migrate away from reliance upon existing legacy systems. The SFA EAI architecture will provide the following technical services:

- Communications Middleware—including core messaging, transport services and event management

- Transformation and Formatting—including data conversion and message translation
- Application Connectivity—including reusable connectivity, application adapters and interface management
- Business Process Management—including enterprise-wide workflow, rules engine and long duration transactions

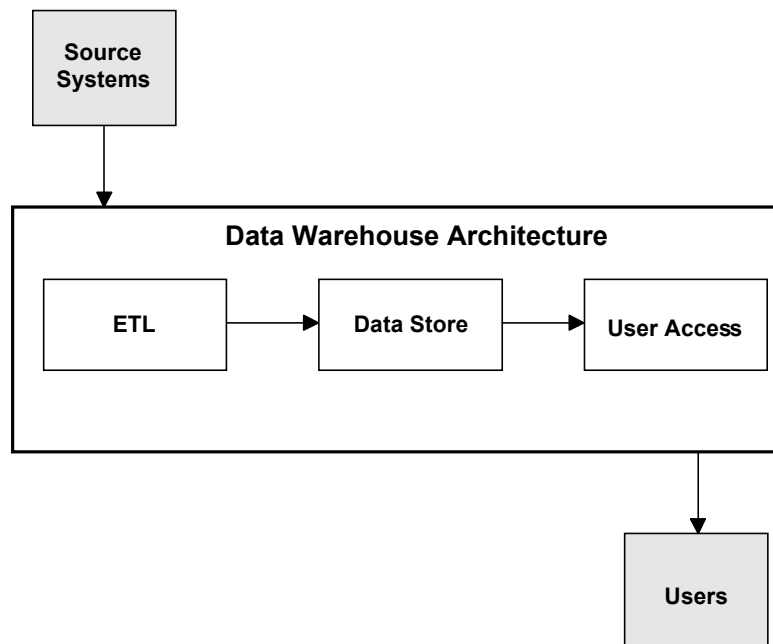
6.2.3 Data Warehouse Architecture

A data warehouse contains read-only, time-dependent data for purposes of end-user access, online analysis and reporting. SFA will develop an enterprise-wide data warehouse that will encompass the data warehouse; data extraction, transformation and loading (ETL); and end user access.

The data warehouse architecture communicates with the Internet architecture, legacy systems, external systems and the EAI. The Internet architecture is the gateway through which the end user will enter the data warehouse, while legacy systems will provide the primary source of data for the data warehouse. User reporting will be drawn from a subset of one or more of the legacy systems. Additional data sources such as external systems may be used to supplement the data in the data warehouse.

Exhibit 6-3 below gives a conceptual view of SFA's data warehouse architecture:

Exhibit 6-3: Data Warehouse Architecture



6.2.4 Legacy Systems Architecture

Virtual Data Center (VDC) environment is used by SFA to process Legacy Systems. This environment is external to SFA. The Legacy System Architecture consists of mainframe, mid-range and network servers. SFA will continue to process major applications in this

environment. The user interface is comprised of industry standard communication and data exchange protocols that tie together across SFA systems to create a single point in the Web environment. This environment presents a standard access to the students, schools and financial partners whether the business channels use the Internet, telephone, fax, or paper.

The business process applications represent SFA business logic contained in the specific applications. The applications will be grouped into five systems: student services, school services, financial services, performance management and enterprise services. Enterprise Application Integration (EAI) software will receive requests then gather the data from databases, process the data and then return the results to the requester. EAI tools will allow independent applications/systems within SFA environment to access shared libraries of logic and data by implementing business rules, performing data integrity checks and routing data to the appropriate applications/systems.

The Internet Architecture is implemented as a set of servers that are connected via the VDC LAN. The VDC environment supports the servers and provides for system management. The VDC provides essential services such as storage and archive storage. Additionally, Internet and Intranet connectivity is provided by the VDC and maintains redundant Internet connectivity through separate service providers and ensure adequate capacity.

The server environment uses the VDC LAN for connectivity between the servers and other VDC equipment such as network storage and legacy systems. Additionally, the Firewall components are provided by the VDC and its implementation is independent of the IA components.

6.2.5 Development Architecture

The Development Architecture defines the development tools, methods, standards and procedures that define the development environment for the Integrated Technical Architecture (ITA). The purpose of the development architecture is to support the tasks involved in the analysis, design, construction and maintenance of SFA business applications.

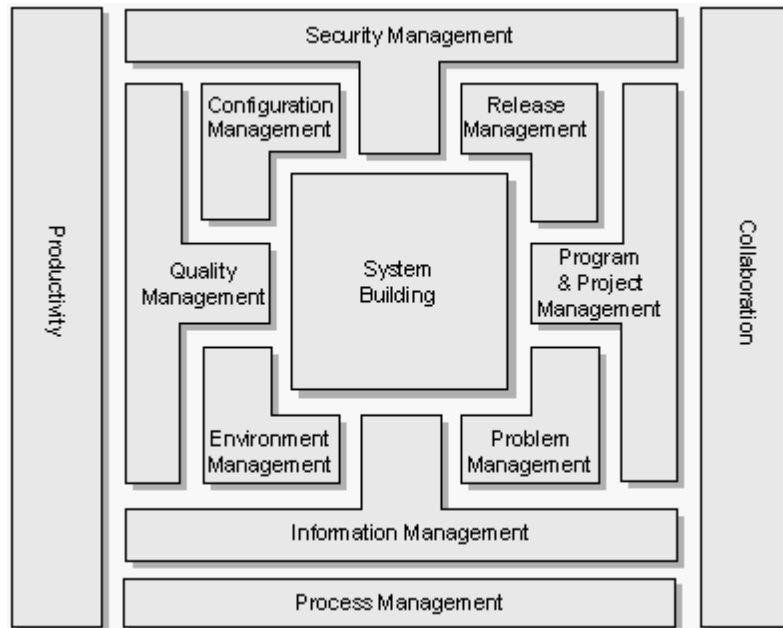
Also, the Development Architecture provides an environment for component-based solutions that support the analysis, design and construction phases of the development process. It is the combination of development tools, methods, standards and procedures essential to a comprehensive, integrated environment for developing and maintaining systems. The development architecture provides a starting point for designing and building a development environment and identifies key concepts and components for the environment.

The SFA Development Framework is based upon an Integrated Development Environment Architecture (IDEA). IDEA provides a development environment framework and associated guidelines that reduce the effort and costs involved with designing, implementing and maintaining an integrated development environment.

The development environment is built upon an integrated set of tools and components, each supporting a specific task or set of tasks in the development process.

The central component, System Building, is supported by the eleven management components as outlined in Exhibit 6-4 below.

Exhibit 6-4: Integrated Development Environment Architecture (IDEA)



The table below provides a brief description of the services provided by Development Architecture.

Development Architecture Component	Description
Information Management Tools	Manage the information that supports the entire project – information that is used both in systems building and in other management processes.
Security Management Tools	Enable the development and maintenance of security components.
Quality Management Tools	Ensure that an agreed-on level of quality in the system is reached. They are also used to provide information and process for improving the quality over time.
Program and Project Management Tools	Assist the management teams in their daily work.
Environment Management Tools	<p>Comprised of the following tools to support Environment Management in the development environment.</p> <p>Change Management – Supports the various aspects identifying and managing change in the development environment, the key tool is the Data & Software Distribution which enables automated distribution of data and software to the workstations and servers of the development environment.</p> <p>Service Management – Supports various aspects of supporting and managing the interface with the developers.</p> <p>Service Planning – Planning required to anticipate and implement changes to the other areas: service management, systems management, change management and strategic planning.</p> <p>System Management – Supports the various aspects of supporting and managing the operation of the distributed system</p>
Release Management Tools	Manages the simultaneous development of multiple releases.
Configuration Management Tools	Covers the version control, migration control and change control of system components such as code and its associated documentation.
Problem Management Tools	Pertain to the problem tracking and solution process.
Productivity Tools	<p>Productivity tools provide the basic functionality required to create documents, spreadsheets and simple graphics or diagrams.</p> <p>Personal Productivity tools are typically packaged as integrated suites of software. These packages provide the basic functionality required to create documents, spreadsheets and simple graphics or diagrams. More recently, the ability to access the Internet and browse electronic documentation has been added to the suite of Personal Productivity tools.</p> <ul style="list-style-type: none"> - Spreadsheet - Graphics - Word Processor

Collaborative Tools	Enable groups of people to communicate and to share information, helping them work together effectively, regardless of location.
Process Integration Tools	Enforce the correct sequencing of tasks and tools in conformance with a pre-defined methodology.

6.3 Systems Management

6.3.1 Overview

Systems Management includes the processes, procedures, tools and techniques that are implemented through personnel and automation to ensure the cost-effective operation of information systems. The procedures and tools ensure proper planning, configuration and problem handling of IT resources. Additionally, Systems Management defines how hardware and software components of the environment will be controlled. It focuses on issues of configuration management, fault detection and isolation, testing, performance measurement, problem reporting and software upgrades.

The Web-based applications will be critical to the success of SFA enterprise. Two major Systems Management areas of importance in any Web-based environment are Testing and Business Continuity Planning. Thorough and effective testing will save wasted time and frustration that results from simple mistakes, or design errors. Early evaluation helps to identify flaws in the design, logic, or flow of the application. SFA should conduct testing early enough to make significant changes. As the applications are better defined, the test should be expanded to include representatives of SFA users. Testing should establish a cross section of subgroups of SFA users.

Some users will be accessing the application remotely. SFA will verify application functionality over these connection methods using test web pages with SFA standard browsers. Load testing will ensure SFA's web application, server and database will perform well with a peak number of simultaneous users. Load testing also helps to verify that multithreaded applications do not contain logic with hidden deadlock conditions. Third-party load testing tools can be employed to assist the load testing activities.

The new Internet services will require an increased dependency for 24 by 7 operations with no downtime. Thus the need for business continuity services will become even more pronounced. Protecting SFA's assets will require a transition to greater dependency on protecting data and the integrity of data, rather than just physical brick and mortar. Providing a comprehensive business continuity plan is crucial for protecting assets, reputation and continued service to all channels.

6.3.2 Functions

The following details specific System Management functions that are to be built by SFA. These Systems Management functions are part of the Information Technology (IT) Management process outlined in Section 3.6.3.5.2 in this document.

User Support Services collects requirements from and coordinates with the users of services. User requirements include change requests, requests for additional service, requests for new

services and problem requests. The user help desk interface function tracks requests and problems until resolution is achieved and provides feedback to the users.

Configuration Management is concerned with maintaining, adding and updating the relationships among components and the status of components themselves during system/network operation. The ultimate end-user service is provided by the configuration of the various system and network components into an integrated and cohesive function.

Inventory Management provides a repository of accurate and timely data about managed resources. Inventories are used to track expected occurrences of the resources against the actual existence of the resources.

Operations Management supports and controls the currently implemented infrastructure. The primary tasks of operations include fault management, performance management, change control, accounting management activities, hierarchical storage management and routine activities.

Load Balancing basically has three major components. The load balancing software, which distributes Web site traffic between servers. Secondly, the caching proxy server captures Web site images that can be retrieved locally in subsequent requests, reducing network traffic. The third component, the enterprise file system, provides content replication.

Network Inventory and Distribution provides a mechanism for centrally distributing and modifying software across distributed environments. For inventory the system would automatically scans for and collects hardware and software configuration information from computer systems in the enterprise.

Quality Assurance helps ensure product and sever quality, provides management with visibility of the processes used in task performance and informs management when potential quality related problems is detected.

Production and Maintenance are day-to-day operations, routine and non-routine maintenance, 24/7 day a week support, system effectiveness and efficiency, service level agreements, IT consumption cost and performance measurement data

Capacity and Performance Management identifies and monitors capacities and performance tuning for the SFA hardware, software and network environments.

System Availability and Contingency Planning process is used to maximize system availability risk mitigation and recovery planning.

6.3.2.1 System Integration and Testing

The overall objective of the testing is to ensure that the systems are ready to go into production. The goal is to ensure that the system is adequately tested in a reasonable amount of time. Testing will include the following.

Stage	Objective
Unit Test	Test each unit of work by focusing on all possible test conditions.
Integration Test	Complete a test that will ensure that the different components work together correctly.
Performance Test	A system test that will ensure that production volumes and processing can be support.
User Acceptance Test	Test in a simulated production environment with all components using test cases that will evaluate all interfaces and workflow.

6.3.2.2 V-Model

The V-model requires three major phases: verify, validate and test prior to implementation. Verification and validation is an attempt to catch problems early in the development life cycle. Additionally, this process should ensure that systems are complete, correct and adhere to standards.

- Verification checks to ensure that the system is correctly derived. Verification will be performed through inspection.
- Validation checks to ensure the requirements are met. An effective technique of validation is completion and review of tractability matrices.
- Testing checks that a specification is properly implemented. Ideally, testing should only uncover problems made in translating the specifications into the product, rather than problems in the specifications themselves.

6.3.2.3 Phase Containment

Then purpose of phase containment is to identify and correct defects before they are passed on to the next phase of the development and testing.

6.3.2.4 Test Data Management

Test data management (TDM) tools are controls and procedures that manage the quality of tests through the management of test data. The primary objective of TDM is to allow users to share and reuse test data throughout the many phases of testing.

6.3.2.5 Version Control

Version control is an essential tool in managing the development and testing process. The need for managing test data, different versions is critical factor in the implementation and maintenance of any system.

6.3.3 Systems Management to Application Matrix

The Systems Management to Application Matrix maps Systems Management functions to the applications that are either managed by or required for performing those functions. The

purpose is to identify the applications that are managed by systems management functions and to identify the applications that are used to perform systems management function.

Exhibit 6-5 below outlines the SFA Systems Management structure that will be built. The entries of the table will be completed during the Evergreening process. SFA Applications from the Application Portfolio are listed across the top row. The intersections of the rows and columns mark the relationship between SFA Systems Management defined functions and SFA applications.

Exhibit 6-5: Systems Management to Application Matrix

Function	Application																			
	C	C	C	D	D	D	D	E	F	F	F	G	I	M	N	P	P	P	R	S
	B	D	P	C	L	L	L	D	A	F	M	A	F	D	S	A	E	M	F	S
	S	S	S	S	C	O	S	E x p r e s s	R S	E L P	S	P S	A P	E	L D S	S	P S	S	M S	I G
User Support																				
Configuration Management																				
Inventory Management																				
Operations Management																				
Load Balancing																				
Network Inventory and Distribution																				
Quality Assurance																				
Production and Maintenance																				
Capacity Planning and Performance Management																				
System Availability																				

System Integration and Testing																			
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6.3.4 Systems Management to Information Matrix

A Systems Management to Information Portfolio matrix maps Systems Management functions to the information that is either managed by or required for performing those functions. The purpose is to identify the information that is managed by systems management functions and to identify the information that is used by systems management functions

Exhibit 6-6 below outlines SFA Systems Management structure that will be build. The entries of the table will be completed during the Evergreening process. SFA Applications from the Information Portfolio are listed across the top row. The intersections of the rows and columns mark the relationship between SFA System Management defined functions and SFA Information Portfolio.

Exhibit 6-6: Systems Management to Information Portfolio Matrix

Functions	Application								
	<i>Student Services</i>	<i>School Services</i>	<i>Financial Partner</i>	<i>Enterprise Performance</i>	<i>Enterprise Services</i>	<i>Participants</i>	<i>Schools</i>	<i>Aid Organizations</i>	<i>Enterprise Financial Services</i>
User Support									
Configuration Management									
Inventory Management									
Operations Management									
Load Balancing									
Network Inventory and Distribution									
Quality Assurance									
Production and Maintenance									

Capacity Planning and Performance Management									
System Availability									
System Integration and Testing									

6.3.5 Systems Management to Infrastructure Matrix

The Systems Management to Infrastructure Matrix maps Systems Management functions to the technical infrastructure components that are either managed by or required for performing those functions. The purpose is to identify the technical infrastructure components that are managed by systems management functions and to identify the technical infrastructure components that are used to perform systems management functions

Exhibit 6-7 below outlines SFA System Management structure that will be built. The entries of the table will be completed during the Evergreening process. SFA functions from the Infrastructure are listed across the top row. The intersections of the rows and columns mark the relationship between SFA System Management defined functions and SFA Infrastructure.

Exhibit 6-7: Systems Management to Infrastructure Matrix

Functions	Infrastructure					
	Internet Architecture	Enterprise Application Integration Architecture	Data Warehouse Architecture	Security Architecture	Development Architecture	Legacy Architecture
User Support						
Configuration Management						
Inventory Management						
Operations Management						
Load Balancing						

Network Inventory and Distribution						
Quality Assurance						
Production and Maintenance						
Capacity Planning and Performance Management						
System Availability						
System Integration and Testing						

6.3.6 Systems Management to Organization Matrix

A Systems Management to Organization Matrix maps systems management functions to the organizations that are either supported by or required for performing those functions. This usually results in new organizations to be added to the Organizational Structure. The purpose is to identify the organizations that are supported by systems management functions and to identify the organizations or roles needed to provide systems management functions

Exhibit 6-8 below outlines SFA System Management structure that will be built. The entries of the table will be completed during the Evergreening process. SFA functions from the Organization Portfolio are listed across the top row. The intersections of the rows and columns mark the relationship between SFA System Management defined functions and SFA Organization.

Exhibit 6-8: Systems Management to Organization Matrix

Functions	Channels		
	Student Services	School Services	Financial Partner Services
User Support			

Configuration Management			
Inventory Management			
Operations Management			
Load Balancing			
Network Inventory and Distribution			
Quality Assurance			
Production and Maintenance			
Capacity Planning and Performance Management			
System Availability			
System Integration and Testing			

6.4 Technology Policies and Standards

As stated in Section 1.1.2 of this document, an ITA must contain a Standards Profile and a Technical Reference Model (TRM). The SFA Technology Policy and Standards Guide provides guidance and pertinent standards, policies and products to be implemented as part of the ITA. See Appendix C, SFA Technology Policy and Standards Guide, for detailed descriptions of the technology policies and standards.

The TRM, which is a conceptual representation of services and interfaces in the information system, is used as a basis for understanding the information technology in the SFA Technology Policy and Standards Guide. Its purpose is to provide a context for understanding how the disparate technologies required to implement information management relate to each other. The TRM classifies the technologies into major service areas and the TRM addresses the infrastructure applications and technology in accordance with these major service areas. Exhibit 6-9 below shows the SFA TRM.

Exhibit 6-9: SFA Technical Reference Model

